DOCUMENT RESUME

ED 281 934 UD 025 485

AUTHOR de Leeuw, Frank
TITLE The Economic Effects of Immigration: Specification of a Model. Impacts of Immigration in California, Policy Discussion Paper.
INSTITUTION Urban Inst., Washington, D.C.
SPONS AGENCY Atlantic Richfield Foundation, Los Angeles, CA.
REPORT NO PDS-85-3
PUB DATE Dec 85
NOTE 45p.; Also supported by the Weingart Foundation, the Ahmanson Foundation and the Times Mirror Foundation. For related documents, see UD 025 486.
AVAILABLE FROM Library/Clearinghouse, Urban Institute, P.O. Box 7273, Dept. C, Washington, D.C. 20044 ($6.00).
PUB TYPE Statistical Data (110) -- Reports - General (140)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Blue Collar Occupations; Business Cycles; Compensation (Remuneration); Demography; Employment Opportunities; *Employment Patterns; *Immigrants; Job Training; *Labor Market; *Mathematical Models; Salary Wage Differentials; Social Change; Socioeconomic Influences; Unemployment; Unskilled Workers; Wages
IDENTIFIERS *Economic Impact Studies; *Immigration Impact; Population Information

ABSTRACT

Many of the arguments behind efforts to reform this nations's immigration laws allege that immigrants, especially illegal immigrants, take jobs away from native workers, depress wages, and receive public services valued in excess of their tax contributions. To provide a basis for appraising these economic arguments, this paper presents a model for simulating the economic effects of immigration. The model is a theoretical framework, useful for understanding how the various economic responses triggered by immigration relate to one another. Simulation of the model shows that the effects of an increase in annual flow of immigrants are highly sensitive to the substitutability between labor and capital and among different kinds of labor; to the responsiveness of wage changes to unemployment; to the presence or absence of wage rigidity; and to the skill mix of immigrants. Effects are also sensitive to regional behavior, specifically to the response of interregional migration and interregional trade to wage and price differentials. The report contains an overview of the model, simulation of the model, and an agenda for future work on the model. Included are a list of references and related titles. An appendix lists the variables, the equations with the coefficients used for the reference simulation, and the alterations for each of the other simulations. (LBW)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

IMPACTS OF IMMIGRATION IN CALIFORNIA

ED281934

POLICY DISCUSSION PAPER

The Economic Effects of Immigration: Specification of a Model

by

Frank de Leeuw

UD 025 485

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

L. Williamson
Urban Institute

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

THE URBAN INSTITUTE

4-14-87

The Economic Effects of Immigration: Specification of a Model

by

Frank de Leeuw

The Urban Institute
2100 M Street, N.W.
Washington, D.C. 20037

December 1985
PDS-85-3

This Policy Discussion Paper was prepared as part of The Urban Institute's larger project, Study of the Impacts of Immigration in California, funded by the Weingart Foundation, the Atlantic Richfield Foundation, the Ahmanson Foundation, and the Times Mirror Foundation. The paper has benefited from comments by Barry Chiswick, Francisco Rivera-Batiz, William Gorham, Albert Hirsch, and Philip Martin. Conclusions or opinions expressed in Institute publications are those of the authors and do not necessarily reflect the views of other staff members, officers or trustees of the Institute, advisory groups, or any organizations that provide financial support to the Institute.

FOREWORD

Issues concerning the level and composition of immigration to the United States have assumed prominent positions on the agendas of many policymakers. Perhaps nowhere are immigration's effects more keenly felt than in California, where one-quarter of all foreign-born persons in the United States currently reside.

This Policy Discussion Paper series is aimed at improving the quality of the policy-making process through a broad distribution of research findings on the consequences of immigration to California. These dissemination activities are part of The Urban Institute's larger project, Study of the Impacts of Immigration in California, funded by the Weingart Foundation, the Atlantic Richfield Foundation, the Ahmanson Foundation, and the Times Mirror Foundation. Important policy issues being addressed include (a) economic and fiscal issues associated with immigration, (b) the character and tempo of assimilation processes, and (c) the impact on California of proposals for immigration reform. All major immigrant groups to California—not just Mexicans—are being included, as are the comparative effects in northern as well as in southern California.

The Urban Institute's objective is to make a positive contribution to the policy process. It is committed to getting its work into the hands of people who can use it and rely upon it to make judgments of their own on future policy directions. Related titles are listed at the end of this paper.

Thomas J. Espenshade
Director
Program in Demographic Studies

THE ECONOMIC EFFECTS OF IMMIGRATION: SPECIFICATION OF A MODEL

Executive Summary

Many of the arguments behind efforts to reform this nation's immigration laws allege that immigrants, especially illegal immigrants, take jobs away from native workers, depress wages, and receive public services valued in excess of their tax contributions. To provide a basis for appraising these economic arguments, this paper presents a model for simulating the economic effects of immigration. The model is not an empirically estimated model, although with additional work it could become one. It is a theoretical framework, useful for understanding how the various economic responses triggered by immigration relate to one another.

The model focuses on employment, unemployment, and wage rates in six submarkets of a national labor market--three in each of two regions. The three submarkets in each region cover (1) unskilled labor, (2) labor whose skills come primarily from on-the-job training and experience, and (3) labor whose skills come largely from formal education. The two regions are a "region of immigration" and a "rest of the country."

Simulation of the model shows that the effects of an increase in the annual flow of immigrants are highly sensitive to the substitutability between labor and capital and among different kinds of labor; to the responsiveness of wage changes to unemployment; to the presence or absence of wage rigidity; and to the skill mix of immigrants. The effects of immigration are somewhat less sensitive to a number of other aspects of labor market behavior. Effects are quite sensitive to regional behavior, specifically, to the response of interregional migration and interregional trade to wage and price differentials.

INTRODUCTION

The free flow of resources in response to market signals often promotes efficiency and produces economic gains for suppliers and demanders alike. If this proposition holds for migration of labor across national boundaries, it means that immigration into a country raises not only the incomes of immigrants, but also the aggregate income of the native population.

Yet in the case of immigration, it is extremely rare for nations to permit the flow to respond freely to market signals. Opponents of unrestricted immigration into the United States argue that, whatever its effect might be in the aggregate, it would depress wages and create unemployment for those workers who are the closest substitutes for immigrant workers and for the regions in which immigrants would settle. Furthermore, unrestricted immigration would allegedly increase government spending—for income support, schooling, and other services—more than it would increase government revenues. Other arguments offered against unrestricted immigration are political and social rather than economic.

To provide a basis for appraising the economic arguments, this paper presents a model for simulating the economic effects of immigration. It is not an empirically estimated model, although with additional work it could become one. At this stage it is a theoretical framework, useful for understanding how the various economic responses triggered by immigration relate to one another. Simulations of the model explore how certain key behavioral responses can influence the results of immigration and therefore illustrate how our understanding of the effects of immigration hinges on measuring the strength of these responses.

The model covers both short- and long-run responses and includes two regions as well as national totals. Without this minimum of detail, the model could never come to grips with some of the key contentions that underlie the immigration policies of this and many other nations; with this detail, the model can serve to integrate a broad range of ideas and empirical findings relating to immigration.

Past economic analyses have focused more on the long-run national effects of immigration than on short-run or regional effects. The long-run national properties of this model are heavily influenced by this previous work, especially the production-function-based analyses by Chiswick (1982b) and by Johnson (1980), and by Chiswick's (1982a) studies of the progress of immigrants in the years after arrival. The model elaborates on the short-run and regional behavior that leads—in some cases rapidly, in others slowly and with detours—to these long-run national outcomes.

The first section of the paper presents an overview of the model with little technical detail. The second section discusses simulations based on hypothetical parameter values; the values are selected to show what kinds of behavior might substantially influence the results of immigration. The third section draws on the results of the simulations to develop an agenda for future research on immigration. An appendix lists the equations of the model and the parameters for the various simulations.

OVERVIEW OF THE MODEL

The model is designed to explain the effects of immigration on employment, unemployment, and wage rates in submarkets of a disaggregated labor market. There are six submarkets; three in each of two regions. In addition to these labor market variables, the model explains the effects of immigration on the following variables in the two regions:

- Output
- Price level
- Stock of tangible capital
- Population
- Government expenditures
- Government receipts.

The principal exogenous variables that drive the model are immigration in each of four groups of the population and three macroeconomic variables directly influenced by government policies and by international economic developments. The four immigrant groups are immigrants of each of the three types of labor and immigrants not in the labor force. The macroeconomic variables are current-dollar gross national product, the cost of capital, and a single national tax rate.

The model contains forty equations; but that number gives a greatly exaggerated impression of its complexity. Most of the equations of the model appear in identical form (though with different values for the variables) at least twice, once for each region; and some of them appear six times, once for each labor submarket. The model contains sufficiently few types of behavior to be easily understandable despite the large number of equations.

This section begins with a note on the two regions into which the hypothetical economy is divided. Next, it explains the equations for the six labor submarkets. It then explains the other equations that are central to the operation of the model—price level, output demand, and capital demand equations. This is followed by a brief summary of the remaining equations. The section concludes with an account of how an increase in the flow of immigration affects the model.

The Two Regions

The two regions in the model are designated as a "region of immigration" and "rest of the country." Although this is a minimal disaggregation, it can be made to fit a variety of situations by altering the parameters that control the size, labor force composition, and other characteristics of the region of immigration.

The regions are interrelated for two different reasons. First, they are part of the same national economy and therefore share the same monetary and national fiscal policies; in the model this is reflected in an exogenous current-dollar income and an exogenous cost of capital for the country as a whole. Second, the regions are linked through trade in goods and migration of labor, which are motivated by economic incentives. The strength of these economic incentives helps to determine the effects of immigration, as two of the simulations below will illustrate.

Labor Market Equations

The three labor markets in each region are tentatively labeled the market for unskilled labor, the market for labor whose skills come primarily from on-the-job training and experience, and the market for labor whose skills come largely from formal professional education. This basis for disaggregation is merely suggestive and can probably be improved; but any disaggregation of the labor market would have the same formal properties as the one delineated here. Each labor market has a labor supply equation, a demand equation for employment, and a wage-change equation. The six labor markets thus account for eighteen of the model's equations, although these eighteen equations represent only three different types of behavior.

Labor Supply. The growth of the labor force in each labor market depends on (a) two exogenous influences, the flow of immigration and a "native" rate of growth reflecting demographic influences; (b) relative wage rates and unemployment rates; and (c) an "immigrant upgrading" effect. The relative wage rates are ratios of "own" wage rates to other wage rates within the region and to wage rates in the same skill-group in the other region. The unemployment-rate variable is the rate for the corresponding skill-group in the other region minus the own unemployment rate.

The immigrant-upgrading effect reflects the relative economic progress of immigrants in the years after their arrival. This progress could, as stressed by Piore (1979), result from willingness of new immigrants to tolerate undesirable jobs for a limited time in the (often mistaken) belief that their stays will be temporary. Alternatively, it could result from self-selection of immigrants from the more ambitious individuals in a society; from a tendency for less successful immigrants to return to their country of origin; or from a diminishing importance, as time passes, of initial barriers to economic advancement such as language problems. Chiswick, who has studied the effect extensively, has noted that its strength varies from one immigrant group to another.

In the model the immigrant-upgrading effect is represented by movement of a fraction of the stock of immigrants from the unskilled market to the skilled-through-training market. The fraction can be varied from one simulation of the model to another, as illustrated in the next section of the paper. The higher the fraction, the more an inflow of initially unskilled immigrants gradually shifts the supply of skilled-through-training workers. This inflow is assumed not to shift the supply of skilled-through-education

workers in the same way; that is one important reason for distinguishing three, rather than just two, labor markets in the model.

Labor Demand. The demand for employment in each market depends on regional output and on real wage rates. The equations provide for a possible time lag in the influence of each of the variables. Apart from time lags, the demand equations are derived from assumptions about cost minimization and the form of the production function relating output to inputs in each region.[1]

Wage Change. The wage-change relation is one of the most controversial among macroeconomists. The model specification is broad enough so that, through alternative parameter values, it can accommodate a wide variety of views. The change from the previous year in the wage rate in each labor market depends on current and past price changes, on employment relative to the labor force, and on the current flow of immigration. Parameters chosen so that a 1 percent price increase produces an immediate 1 percent wage increase (other things being equal) would reflect "rational expectations" views about wage determination. Parameters chosen so that a 1 percent price increase produces a smaller wage increase, even in the long run, would imply long-run "money illusion."

In most simulations of the model the parameters are selected so that a 1 percent price increase causes an eventual, but not an immediate, 1 percent wage increase. There is thus no long-run money illusion in most simulations. In one of the simulations, however, this equation is allowed to hold only if

---

[1]The model uses a constant elasticity of substitution, or CES, production function relating output in each region to the three kinds of labor input and the capital stock in the region. One simulation shows the effect of varying the elasticity of substitution. More complex production functions would complicate the employment and price equations of the model.

it produces positive wage changes; if it produces wage reductions, it is overriden by the condition that wages are unchanged. The results of this simulation suggest that the effects of immigration are sensitive to the possible presence of wage rigidity.

Price, Output, and Capital Demand Equations

The price, output demand, and capital demand equations are the other key determinants of the operation of the model. They augment the labor market equations to make the model a complete, if highly simplified, representation of an entire economy.

Prices. The price of what is produced in each region depends on wage rates, the cost of capital, and a time trend denoting technological progress. The cost of capital is treated as exogenous on the grounds that it is very sensitive to the mix of monetary and fiscal policies and the detailed provisions of the tax code—matters beyond the scope of this model. The algebraic form of the price equation forces input-output relations to approach a CES production function in the long run. Other algebraic forms would be appropriate to other production functions.

Output. At the national level, aggregate output is identically equal to income in current dollars divided by the national price level. Income in current dollars is treated as exogenous, on the grounds that it is highly sensitive to monetary policy, fiscal policy, foreign economic developments, and other forces beyond the scope of this model. The model is consistent with many theories about the determinants of income in current dollars.

The model explains not only aggregate output but also its division between the two regions. Relative prices in the two regions determine the proportion of national output produced in each respective region, reflecting

the sensitivity of buyers to interregional price differentials. Both buyer sensitivity to price differentials and sensitivity of the labor force to regional wage and unemployment differentials, which show up in the labor force equations, are key determinants of the relative regional effects of immigration.

Output is not disaggregated by commodity. Distinguishing between traded and nontraded goods or between farm and nonfarm products might enrich the model but would also enlarge and complicate it.

Capital Stock. The demand for tangible capital stock in each region, like the demand for employment, depends on regional output and on costs, and is derived from the CES production function. In the region of immigration, the model also allows for the possible importation of capital by new immigrants. Lags are permitted in the responses to output and costs. In the case of capital goods the cost variable resembles an interest rate and is the same for both regions.

Other Equations

The model contains eight additional behavioral equations that are influenced by the outcome of the rest of the model but do not feed back on the model to any significant extent, at least during the twenty-year period of the simulations. The model also contains six mathematical identities (in addition to the one already described for national output).

Behavioral Equations. Four of the additional behavioral equations describe the actions of regional governments. One equation for each region relates government expenditure to the region's output, unemployment, nonlabor-force population, and increase in population, all multiplied by the regional price level. A tax equation for each region, based on the assumption that

regional governments try to balance their budgets, sets the effective regional tax rate equal to last year's ratio of government expenditures to output.

Two equations describe the expenditure and tax decisions of the national government. National government expenditures, like regional government expenditures, depend on output, population outside the labor force, and unemployment. The equation for national tax receipts does not assume a budget-balancing goal. Rather, tax receipts depend on an exogenous national tax rate multiplied by national income in current dollars. Tax receipts also depend on the change from the previous year in current-dollar income, on the ground that some highly taxed forms of income account for a disproportionate share of short-run fluctuations in total income.

The dependence of expenditures on unemployment is the only way in which a decline in the private sector economy causes government spending to increase. The equations for the national government do not at present provide for expenditures that vary directly with the number of low-income people. Nor do the national government equations embody any stabilization policy; they do not, that is, attempt to answer the question of what levels of government spending and tax rates are necessary, in the face of a disturbance such as a change in immigration, to keep the cost of capital and current-dollar income on their assumed exogenous paths.

Levels of government spending (regional and national) affect the rest of the model, principally because the employment equations of the model provide for employment in government as well as in the private sector. For plausible values of the coefficients of the government equations, however, the effect is small enough to ignore in this discussion.

The effects of immigration on government expenditures and receipts are in reality sensitive to whether immigration is legal or illegal. Illegal immigrants make less use of government services, and in some cases pay fewer taxes, than similarly situated legal immigrants. In the model the immigration variables do not distinguish between legal and illegal immigrants, but the effects of the distinction can be explored by simulating the model under two or more sets of coefficients for the government equations (and perhaps other equations as well), one set appropriate for legal immigrants and one for illegal immigrants.

The two remaining behavioral equations describe the population in each region. Population in each region is divided into four groups—three kinds of labor and persons outside the labor force. Population change depends on exogenous rates of natural increase and decrease (birth rates minus death rates) for each of the four groups, on immigration into each of the four groups, and on interregional differences in prices, wage rates, and unemployment. The interregional variables have effects that cancel out for the entire country.

Identities. Six identities complete the model. Two calculate average wage rates, one for each region, and two calculate aggregate unemployment rates, one for each region. One calculates aggregate output for the nation as the sum of output in the two regions. The final one calculates an implicit price level for the nation, equal to national income in current dollars (exogenous) divided by national output.

How the Model Behaves

An account of how the model behaves can provide a qualitative understanding of how it handles an increase in the flow of immigration in one

submarket--for example, an increase from a small to a large flow of unskilled immigrants per year. It is helpful to begin by describing the effects on the labor market as a whole, then take up the differential effects on different labor submarkets, then turn to the interregional effects, and finally consider the government-sector effects.

Initially a rise in the flow of immigration increases the labor force. The larger labor force reduces the change in wage rates, and the wage reduction stimulates employment. As long as the employment change is smaller than the initial labor force change, there is an initial increase in unemployment. At the same time, the reduction in wage change reduces the change in prices. Because current-dollar income is given exogenously, the moderation of prices leads to higher output, which stimulates employment further and also increases the capital stock. The new equilibrium growth path toward which the economy moves will be characterized by higher output, employment, and capital stock and lower real wage rates than the old path. Any initial increase in unemployment is reduced as employment expands; but because a new group of immigrants arrives each year, the unemployment effect may never wholly disappear.

The wage and unemployment effects can differ sharply by type of labor if immigration is concentrated in one type. The initial labor force increase, wage moderation, and employment increase will be concentrated in the submarket that immigrants enter. The resulting greater output will lead to employment increases in other submarkets, and these increases in turn will raise, rather than lower, wages in these submarkets. The new equilibrium growth path, as already noted, will have lower average real wage rates; but the average is composed of a real wage decrease in one submarket and real wage increases in others.

An added complication arises if the increased flow of immigrants to the unskilled submarket improves its skills and, in part, upgrades to the submarket of workers skilled through training. As the upgrading takes place, this latter submarket begins to respond to growing supply in the same ways as does the unskilled submarket. If enough upgrading occurs, it may cause lower rather than higher real wage rates in the skilled-through-training submarket.

Regionally the responsiveness of labor supply to differences in wage and unemployment means that a disturbance in one region is diffused among other regions. Wage and price changes in the region of immigration are moderated by this regional diffusion, while changes in the rest of the country echo to some extent the changes in the region of immigration.

The regional responsiveness of demand to price differentials has more complex consequences than the responsiveness of supply. Because national demand in current dollars is treated as exogenous, higher current-dollar demand in one region means lower current-dollar demand in the rest of the country. A disturbance that causes prices to rise in one region can, under some parameter values, lead to an unstable outcome in which output in one region continues to grow and output in the rest of the country shrinks. Under other (presumably more realistic) parameter values, a disturbance leads to stable new regional shares.

The effects on government expenditures and receipts depend on output, unemployment, and population outside the labor force. Regionally government receipts respond to expenditures. In the long run, growth or shrinkage of regional government follows the behavior of regional output.

SIMULATIONS OF THE MODEL

All simulations in this section, except the last one, describe the hypothetical effects on key model variables of a large increase in the annual flow of immigration into the unskilled labor market in the "region of immigration." The model can simulate many other changes, but this one is sufficient to indicate that with plausible parameter changes the model can generate a wide range of outcomes.

All simulations, except the last one, increase immigration of unskilled workers above the baseline path by 1 million immigrants in the first year. The increase over the baseline path grows in succeeding years at a rate of 2.5 percent per year. National population (including immigrants) is 205 million in the first year and grows by an average of 2.3 percent per year. The increased flow of immigration adds, on average, 0.5 percent more people per year to the total population; 2.5 percent to the national supply of unskilled workers; and 5 percent to the supply of unskilled workers in the region of immigration.

The first simulation is designated as the reference simulation because each succeeding simulation is compared to it. The parameter values for the reference simulation, like those for all other simulations, are hypothetical; the reference simulation is useful solely as an expositional aid. The succeeding simulations illustrate the effect on the model's behavior of:

- a change in the substitutability among capital and the three types of labor;
- a change in the speed of upgrading labor skills by unskilled immigrants;
- a change in the sensitivity of wage rates to unemployment;
- the imposition of downward rigidity of wage rates;

- o a change in the sensitivity of regional labor supply to wage and unemployment differentials between regions; and
- o a change in the sensitivity of aggregate demand to regional price differentials.

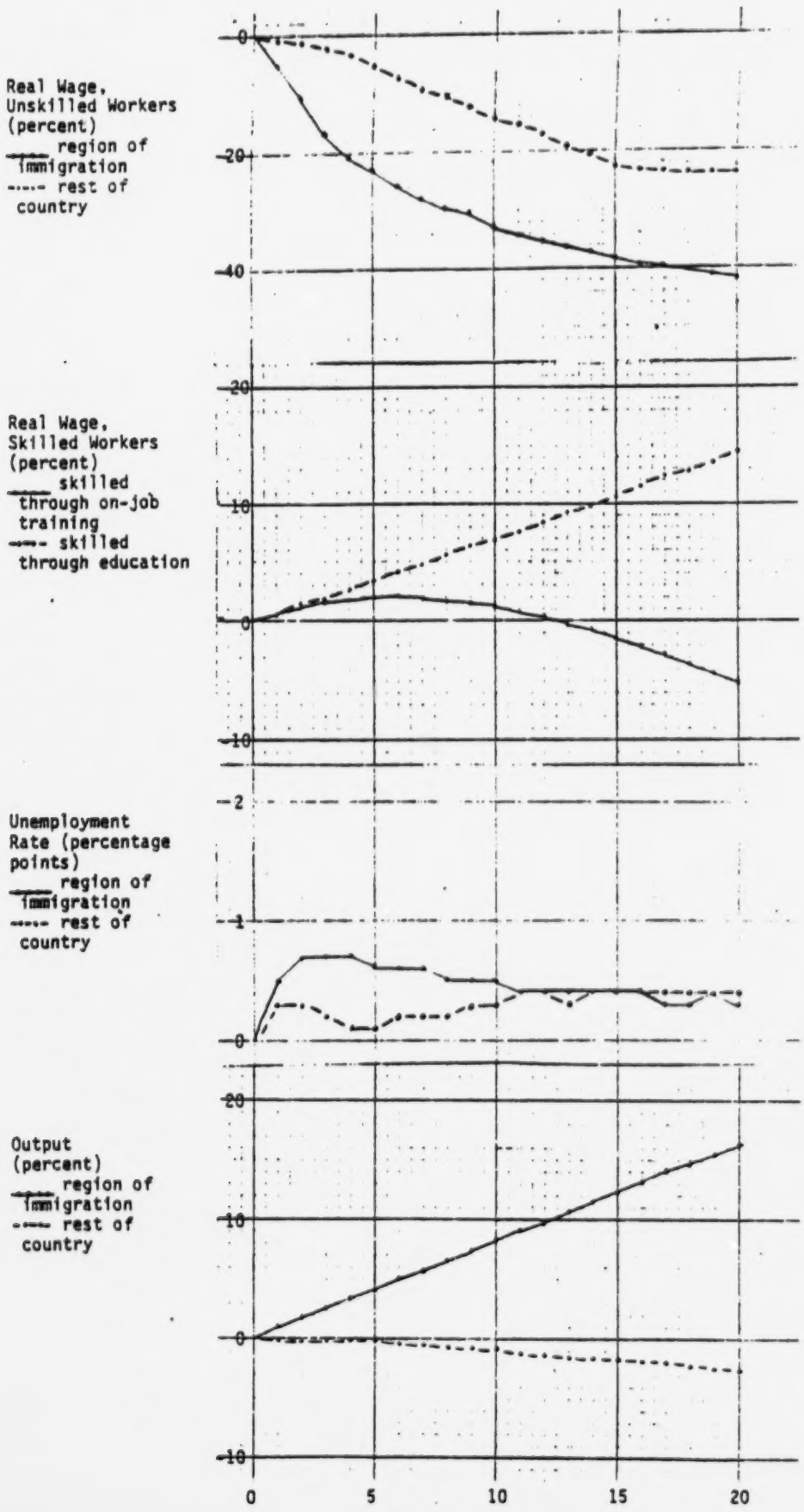
The final simulation changes the skill distribution of immigrants. The total number of immigrants each year is the same as in the other simulations, but only 60 percent of them enter the market for unskilled labor.

The Reference Simulation

Key outcomes for the reference simulation are depicted in chart 1. The chart shows percent differences from a baseline run of the model to a run with an increased annual flow of unskilled immigrants as described above. The chart does not show the full model output, but only a small number of variables: wage rates by submarket and region, unemployment rates by region, and output by region.

The first panel of the chart shows the impact of the higher flow of immigration on wage rates for unskilled labor in the two regions. In the first year, the higher flow of immigration lowers the wage rate in the region of immigration by a little more than 5 percent, compared to the baseline wage rate for this submarket. In the second year, the new group of immigrants plus the continuing effects of the first year's group lower the wage rate in this submarket by 11 percent, compared to the baseline. By the twentieth year the unskilled wage rate in the region of immigration is 42 percent below the baseline value. Later simulations will demonstrate that the size of this wage reduction is highly sensitive to a number of parameters and assumptions. Unskilled wage rates in the "rest of the country" also fall, due to the strength of interregional connections. By the twentieth year unskilled wage rates in the rest of the country have declined about 70 percent as much as in the region of immigration.

Chart 1: Reference Simulation



The next panel shows wage rates for other types of labor, both as national averages rather than in regional detail. Initially, wage rates in both submarkets rise relative to the baseline. Eventually, however, the upgrading of unskilled immigrants puts supply pressure on the skilled-through-training submarket. Wages in that submarket fall relative to the baseline, while wage rates in the skilled-through-education submarket continue to rise. The income of the nonimmigrant population as a whole benefits slightly from immigration. The reference simulation is thus consistent with the proposition described in the first paragraph of this paper (assuming that the capital stock is owned by nonimmigrants, and that immigrants are taxed according to the same schedule as nonimmigrants). The chart, however, does not show this aggregate result but focuses instead on the separate impacts on different labor submarkets and on the two regions.

The unemployment rate in the region of immigration, shown in the next panel, first rises and then falls relative to the baseline. The group of immigrants that enters each year creates a pattern of initially high unemployment followed by absorption into the employed labor force. The regional unemployment rate is the sum of this pattern over immigrants entering in current and past years. At first, the initial increases in unemployment outweigh job creation; but as time passes job creation becomes the greater influence and the unemployment rate falls back toward its baseline level. By the twentieth year the increase over baseline unemployment is only 2.6 percent of the cumulative increase in immigration. The unemployment rate in the "rest of the country" increases slightly over the baseline and displays a barely perceptible cyclical fluctuation.

Output, depicted in the bottom panel of the chart, increases as the immigrants find jobs. In the reference simulation the output increase is concentrated entirely in the region of immigration. Output in the rest of the country, in fact, is slightly below the baseline, as skilled labor and capital shift to the region of immigration where they are in strong demand.

Greater Substitutability of Inputs

Chart 2 shows the effect of changing one parameter of the model, the elasticity of substitution among the three types of labor and capital. This parameter, which describes how adaptable output is to changes in the composition of inputs, is set at 0.5 in the reference simulation and is raised to the higher value of 1.5 in the simulation depicted in chart 2.

The wage impacts of immigration are greatly affected by this parameter change. By the twentieth year unskilled wage rates in the region of immigration are only 23 percent below the baseline, compared with 42 percent in the reference simulation. Other wage and unemployment effects are also much smaller. Output effects, however, are slightly larger because the higher elasticity of substitution reduces the degree of diminishing returns to unskilled labor.

Faster Immigrant Upgrading

Chart 3 shows the effects of changing the parameter of the model governing the rate at which initially unskilled immigrants shift from that submarket to the skilled-through-training market. In the reference simulation the number upgraded in each year is equal to 3 percent of the stock of unskilled immigrants. In the simulation depicted in chart 3 the annual percentage is raised from 3 to 6.

Chart 2: Greater Substitutability of Inputs

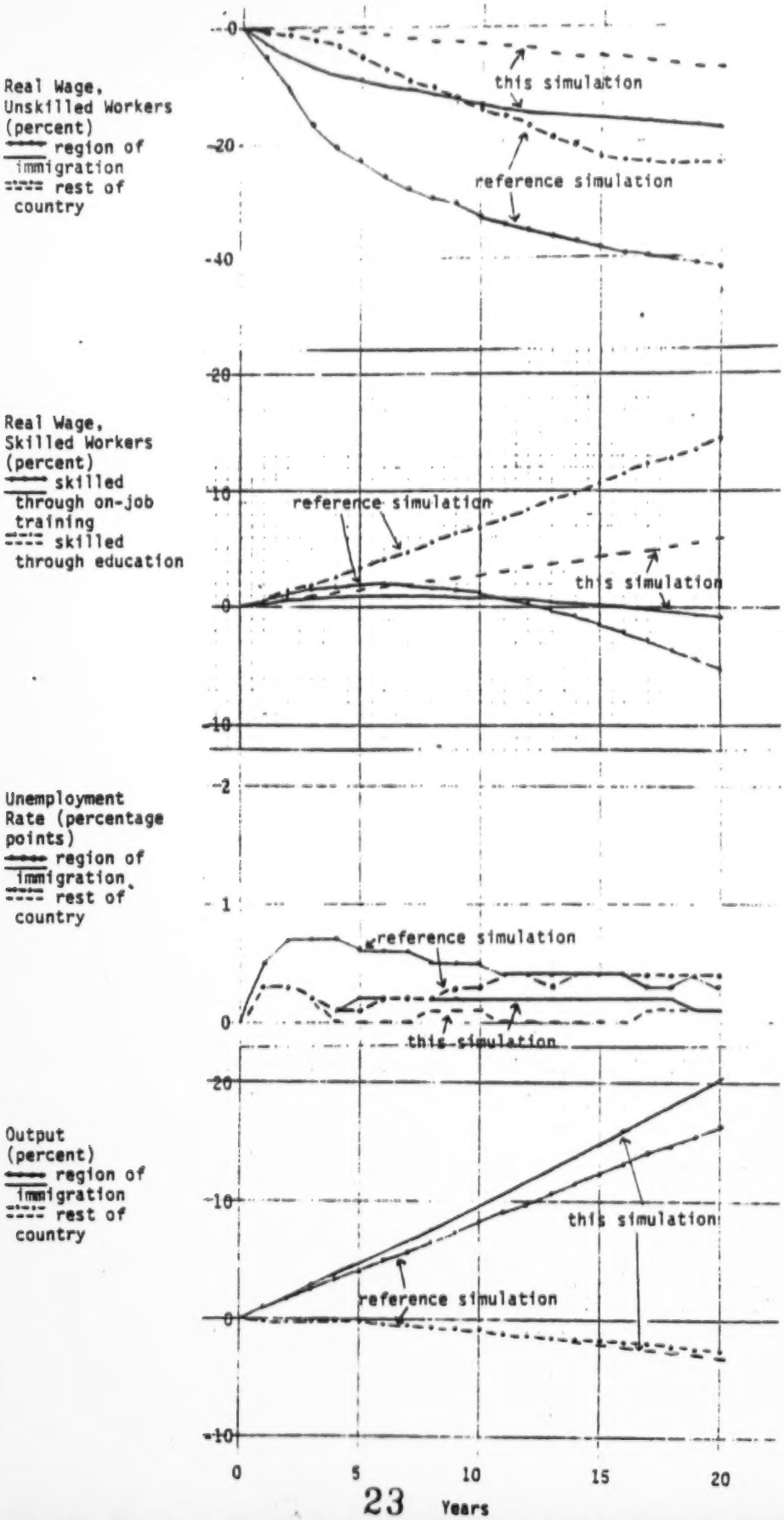
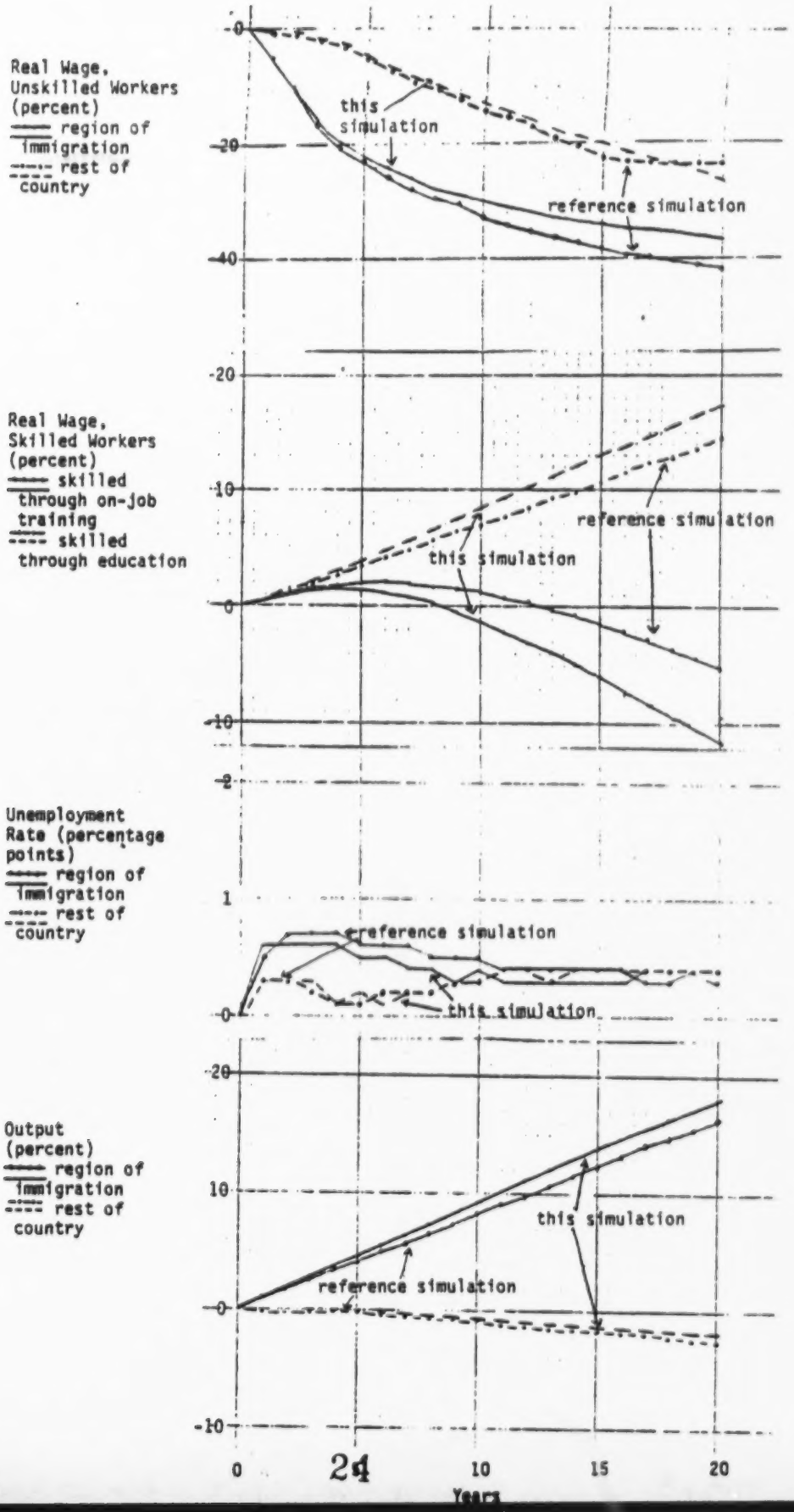


Chart 3: Faster Immigrant Upgrading



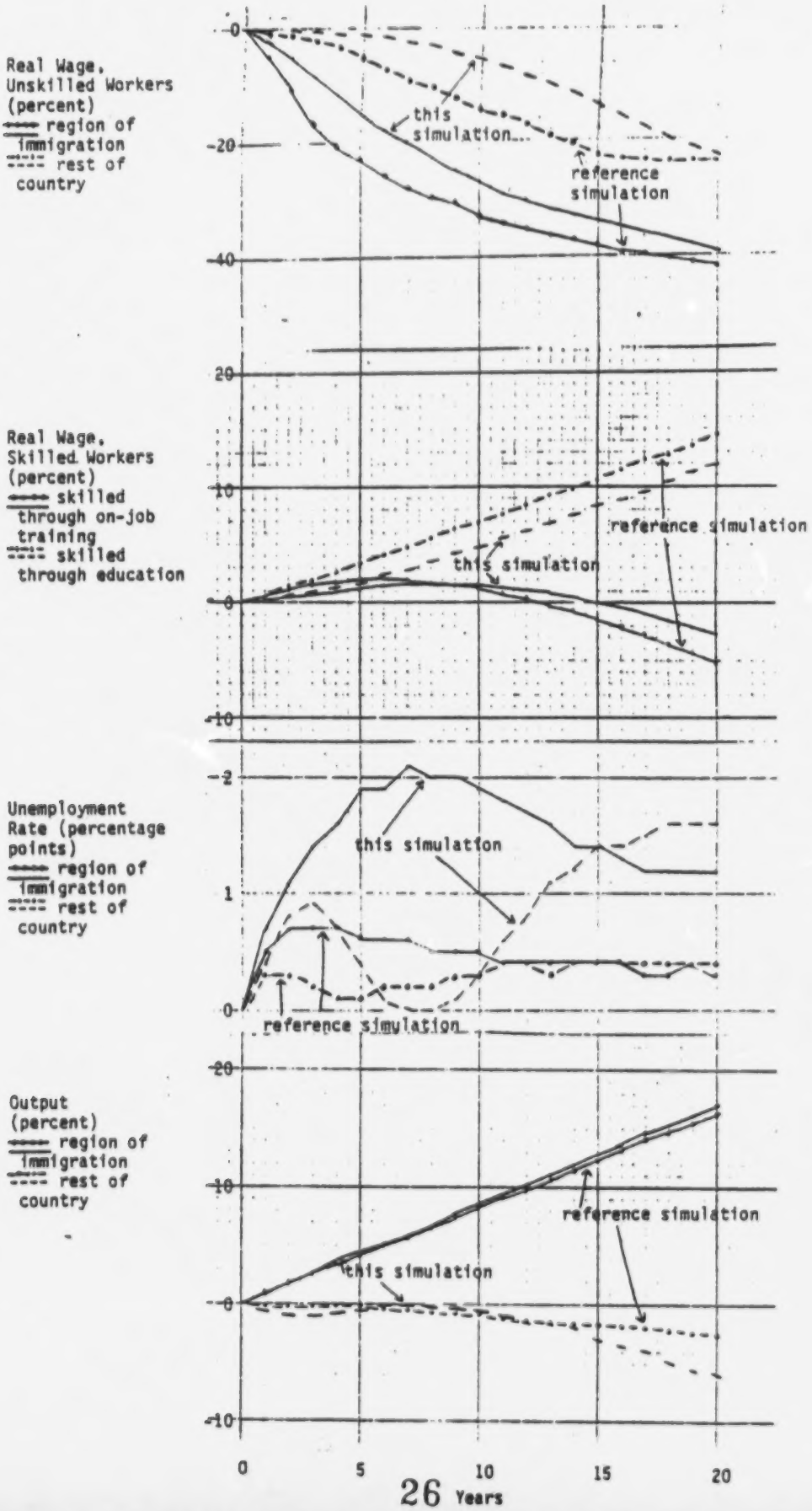
This parameter change has smaller effects than the change in the elasticity of substitution depicted in the previous chart. The largest impact is on the skilled-through-training wage rate, which by the twentieth year falls 12 percent in this simulation, compared to 5 percent in the reference simulation.

Sensitivity of Wages to Unemployment

Chart 4 shows the effects of changing the parameter governing the sensitivity of wage changes to unemployment. In the reference simulation, wage rates in each submarket respond by 2 percent for each 1 percent change in the utilization of labor (employment as a fraction of labor force). In the simulation depicted in chart 4, the elasticity is lowered from 2.0 to 0.5.

This parameter change substantially affects the results, especially for unemployment rates. The unemployment rate in the region of immigration rises by a peak of 2.1 percentage points compared to 0.7 percentage points in the reference simulation. Gradually, interregional migration diffuses the unemployment impact, diminishing it in the region of immigration but increasing it in the rest of the country.

Despite higher unemployment, output rises by slightly more in this simulation than in the reference simulation by the twentieth year. The source of this result is the composition of unemployment (not shown in the chart); unskilled unemployment is higher but skilled unemployment is lower. The former effect dominates in a count of the unemployed, in which people are weighted equally; but the latter effect dominates in its impact on output, in which people are weighted by their respective real wages.


Real Wage, Unskilled Workers (percent)
region of immigration
rest of country
this simulation
reference simulation
0
-20
-40
Real Wage, Skilled Workers (percent)
skilled through on-job training
skilled through education
reference simulation
this simulation
20
10
0
-10
Unemployment Rate (percentage points)
region of immigration
rest of country
this simulation
reference simulation
2
1
0
Output (percent)
region of immigration
rest of country
reference simulation
this simulation
20
10
0
-10
0
5
10
15
20
Years

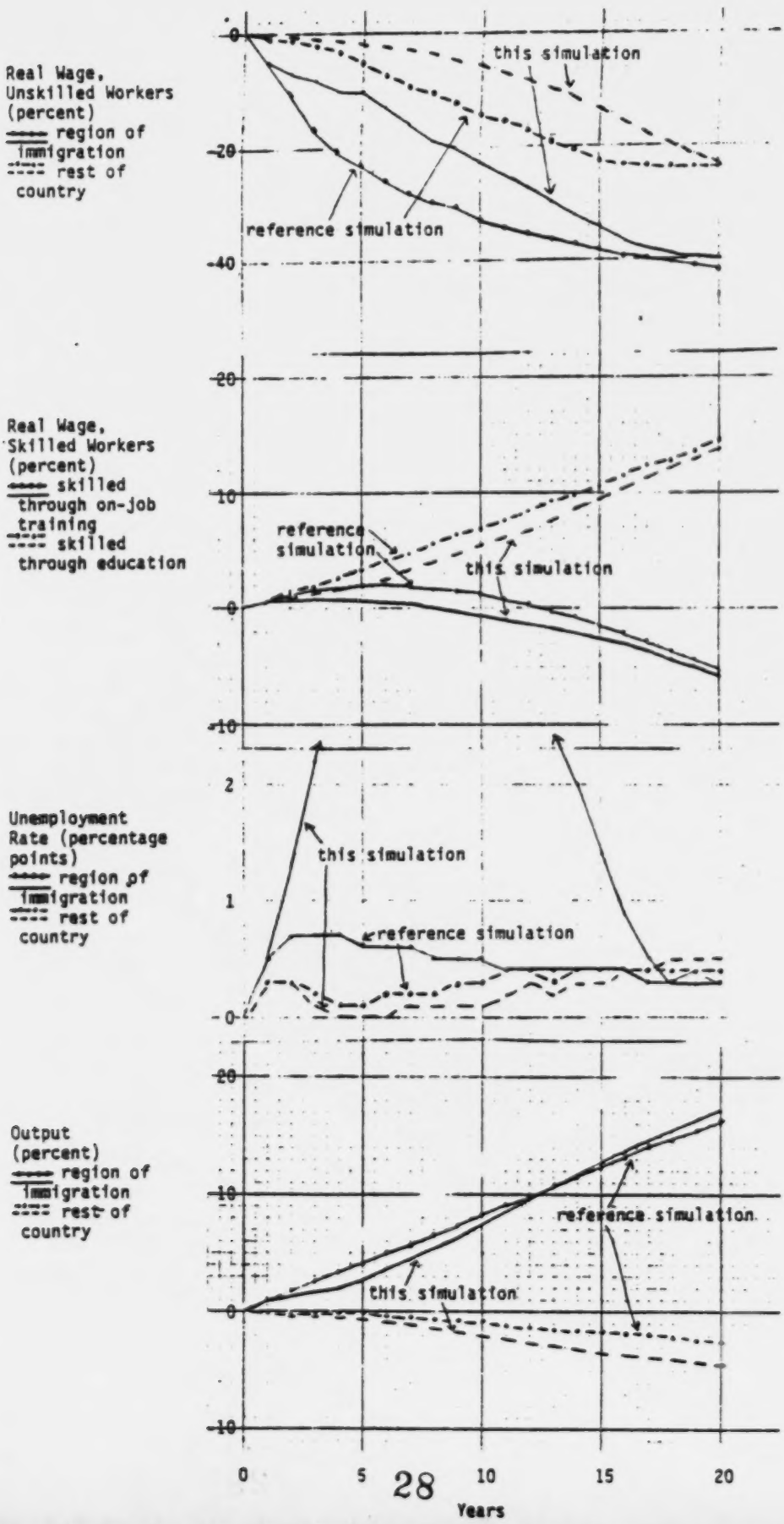
Wage Rigidity

Chart 5 shows the effects of imposing rigidity of nominal wage rates, a possibility stressed by Piore (1979) and others. In the reference simulation, wage-change relations are the same whether they cause wages to rise or to fall. In the simulation depicted in chart 5, the wage relations of the reference simulation are overriden if they lead to reductions in nominal wage rates. In these cases the wage rates are held constant at the previous year's level.

The impact of downward wage rigidity clearly depends on the trend of wages produced by all of the assumptions and initial conditions of the model. If that trend is strongly upward, the imposition of downward rigidity of wages would have little or no effect on the model. If that trend is generally downward, rigidity of wages could have substantial long-run as well as short-run effects.

The results shown in chart 5 illustrate an intermediate case. Downward rigidity of wage rates has substantial short-run effects on model outcomes, but only minor long-run effects. Unskilled wage rates fall much less than in the reference simulation in the third through tenth years, but almost as much by the twentieth year. The unemployment rate in the region of immigration rises much more than in the reference simulation starting in the second year, but by the same amount in the twentieth year. The impact of wage rigidity dies out when the forces at work in the model become strong enough to raise wage rates above initial levels even in the face of the increase in immigration.

Chart 5: Downward Wage Rigidity



Interregional Sensitivity

Supply. Chart 6 shows the effects of reducing the sensitivity of labor supply to regional differentials in wage rates and unemployment rates. In the reference simulation, the labor force in each submarket changes by 0.02 percent per year for each 1 percent regional difference in wage rates and for each 1 percent regional difference in labor utilization. In the simulation depicted in chart 6 the sensitivity is reduced to zero.

This parameter change amplifies differences between regions. In the region of immigration the unskilled wage reduction is greater and the unemployment increase is larger than in the reference simulation. In the rest of the country immigration has zero impact on unskilled wage rates and unemployment. Output impacts are consistent with unemployment impacts: a smaller increase than in the reference simulation in the region of immigration, and no change in the rest of the country.

Demand. Chart 7 shows the effects of reducing the sensitivity of demand to regional price differences. In the reference simulation, the quantity demanded in the region of immigration falls by 1 percent for each 1 percent increase in the relative price of output in that region. (The quantity demanded in the rest of the country is derived as a residual because total nominal income in the country is an exogenous policy variable in the model.) This price elasticity of -1 means that an increase in relative prices in the region of immigration leaves demand in current dollars unchanged; the reduction in the quantity demanded is matched by the higher price paid for the quantity purchased. In the simulation depicted in chart 7 demand is less sensitive to prices; the long-run elasticity is lowered from -1 to -0.7. A higher price in one region, in this simulation, increases the flow of current

Chart 6: Less Interregional Supply Sensitivity

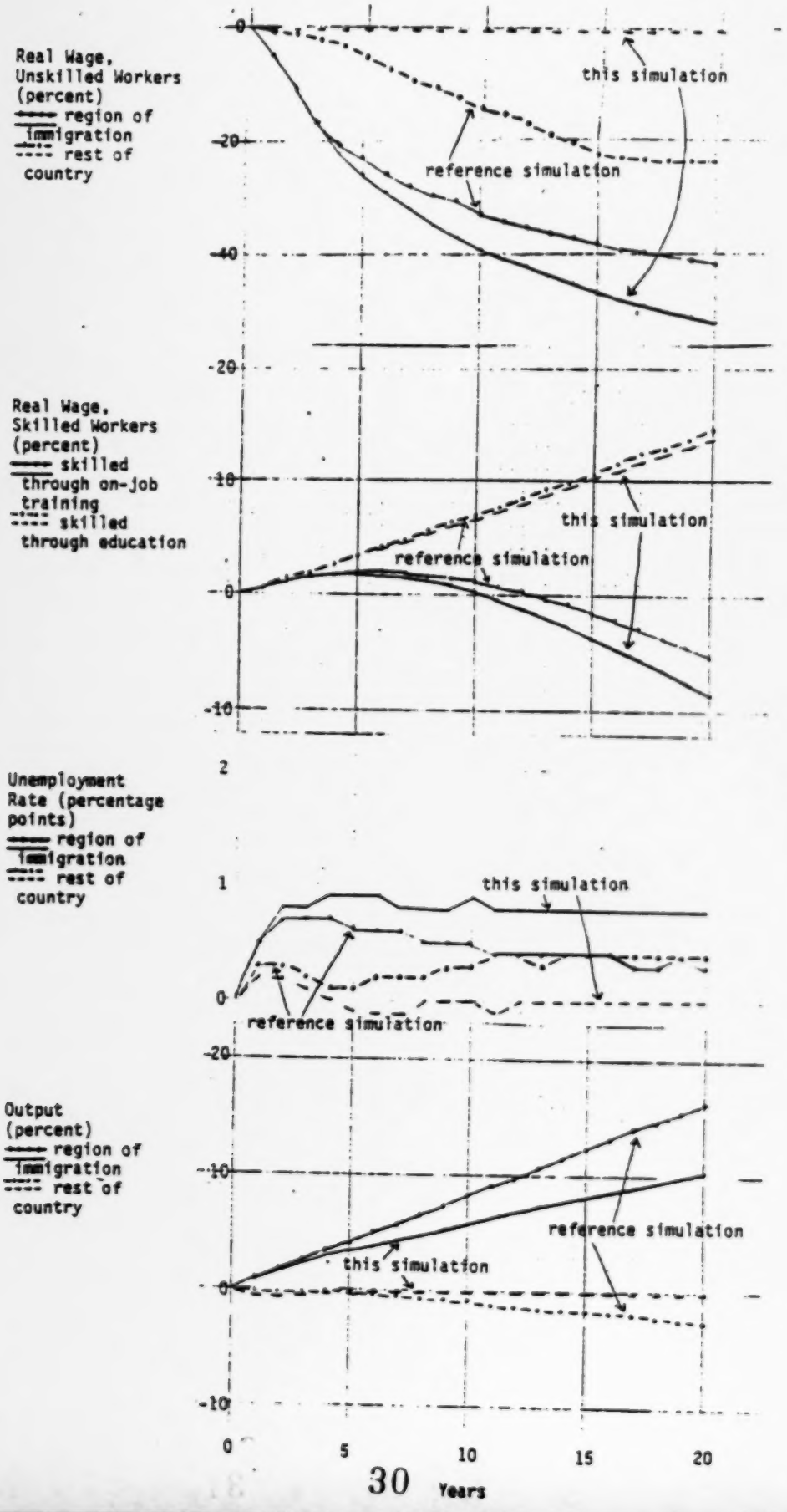
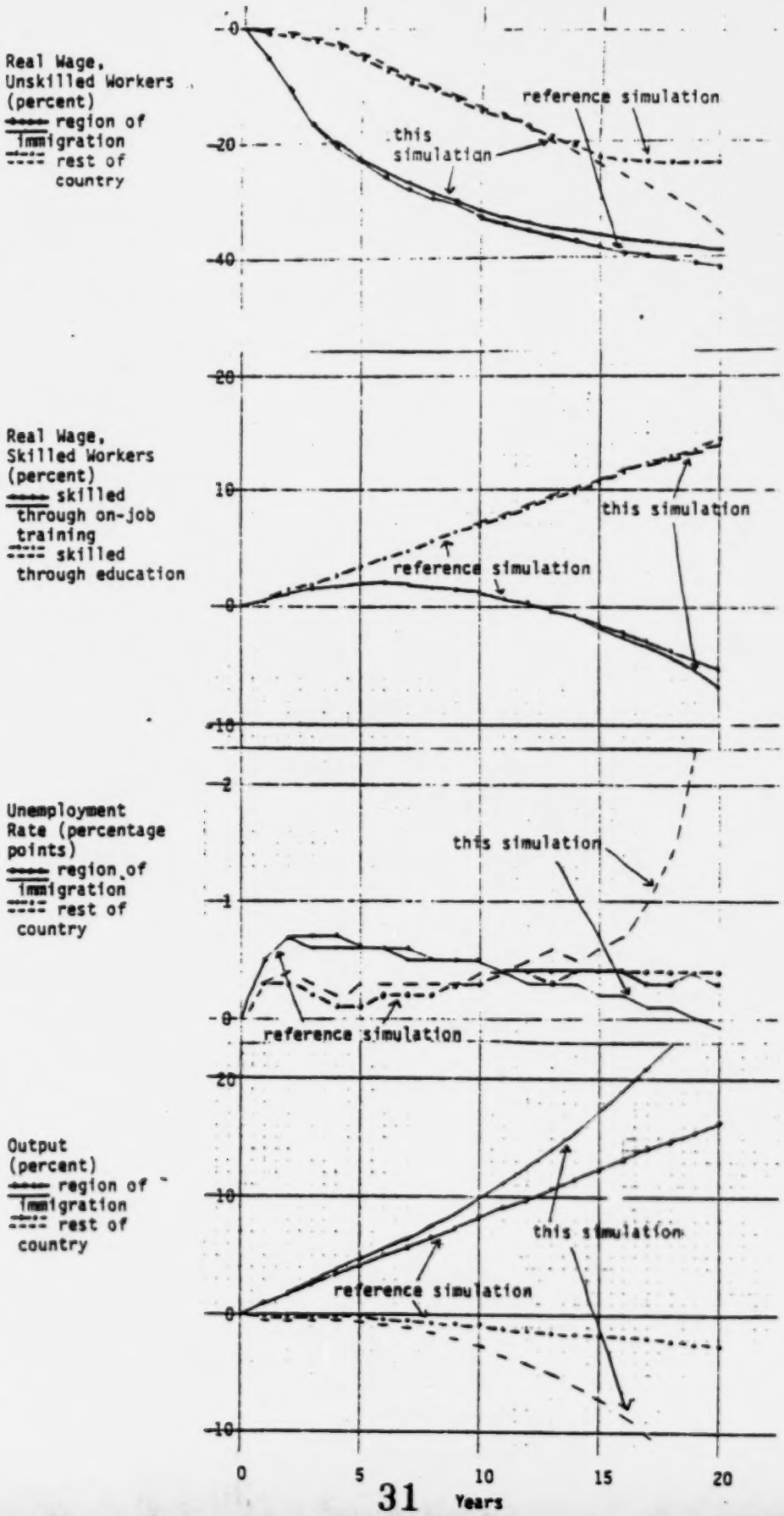


Chart 7: Less Interregional Demand Sensitivity



dollars to that region, and therefore curtails the flow of dollars to the rest of the country.

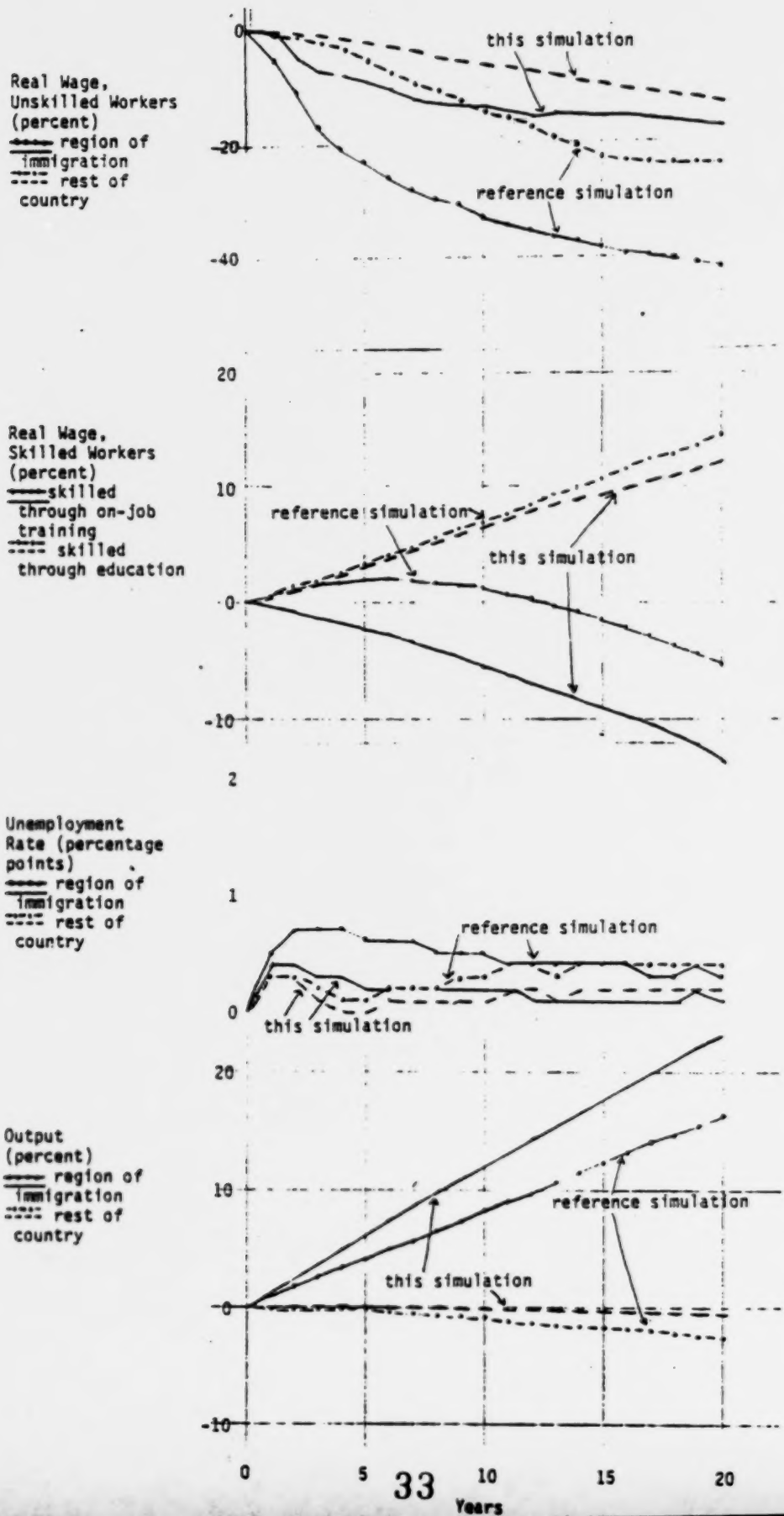
This reduction in regional demand sensitivity has only minor effects on the initial-year outcomes; but it has large and destabilizing effects in later years. In the final years of the simulation a strong expansion in the region of immigration reduces unemployment and increases output in that region; meanwhile, the rest of the country suffers a deep depression. Evidently, regional shares in the model are dynamically unstable for certain parameter values. Since this is not a plausible outcome, it means that either these parameter values are unrealistic or the regional demand equation of the model needs to be reformulated.

Change in the Skill Distribution of Immigrants

The final simulation, depicted in chart 8, shows the effects of a more even skill distribution of immigrants. Instead of all immigrants entering the submarket for unskilled labor, as in the other simulations, 60 percent enter that submarket, 30 percent enter the submarket of labor skilled through training, and 10 percent enter the submarket of labor skilled through formal education. The total number of immigrants each year is the same as that in the other simulations, and all other assumptions are the same as in the reference simulation.

A more even skill distribution of immigrants greatly reduces the downward pressure on unskilled wage rates, as the first panel of the chart shows. The reduction in wage rates is less than half as much in this simulation as in the reference simulation. Unemployment effects are also much less severe in this simulation, and the increase in output is larger. The reduction of wage rates for workers skilled through training, however, begins sooner and is greater in this simulation.

Chart 8: More Even Skill Distribution of Immigrants



AGENDA FOR FUTURE WORK

This paper accomplishes two tasks, specification of a model and sensitivity analysis—that is, simulation of the model under a range of hypothetical conditions. The next steps in developing the model to improve understanding of immigration are review and revision of the specification, more simulation of the present model or a respecified version, and estimation of key parameters of the model. The paragraphs below discuss each of these steps in turn.

Specification

The present specification of the model draws heavily from past work in several branches of economics. The specification has not, however, been reviewed and criticized by experts in the economics of immigration. Nor has it been specified with detailed attention to the availability of data. External review and careful evaluation of data sources will likely produce changes in specification.

Continuous time-series data corresponding to each variable of the model are not necessary in order for the model to be operational. Nevertheless, sufficient data are needed—whether from time series or other sources—to estimate the parameters of the model and to set realistic initial conditions for conducting simulations.

Additional Simulations

Simulations of the model presented in this paper have shown the potential importance of a range of parameters in determining the effects of immigration. Changes in substitutability of inputs, sensitivity of wage rates to unemployment, rigidity of nominal wage rates, and skill composition of the immigrant labor force all have dramatic effects on model results in these

simulations. Changes in the speed of immigrant upgrading and in the sensitivity of labor supply to regional differences have less dramatic, but still noticeable effects. A change in the sensitivity of demand to regional price differences has large but implausible effects, which suggests that respecification of the interregional demand equation may be desirable.

The simulations reported in the paper do not exhaust the list of changes that might have significant impacts on model results. Changes in the lag structure of the wage-change equations and the employment demand equations would probably alter some of the results significantly. Changes in the sensitivity of submarket labor supply to wage differences between skill groups have not yet been simulated (in contrast to changes in sensitivity to wage differences between regions). Readers will perhaps have their own candidates for simulation of this model or a respecified one.

The model can simulate the effects of emigration as well as of immigration. Results for emigration will not be simply the reverse of those for immigration because many of the initial conditions and perhaps some key parameters differ between countries that typically export labor and those that import labor. It would be worthwhile preparing at least a few hypothetical simulations of the effects of emigration before proceeding to a revised specification of the model.

Estimation

At least three bodies of empirical work bear directly on the parameters of the model. The first is research on long-run production functions, which contains estimates of the substitutability and complementarity of inputs into production disaggregated in various ways. The second is work on short-run labor market adjustment, which contains estimates of the flexibility of wage

rates and their sensitivity to excess supply or demand. The third is interregional migration studies, which contain estimates of the response of labor force to regional differences in wage rates and unemployment rates. Review of all three bodies of literature should be the first step in making this model operational.

There is, however, no standard recipe for estimating a model that emphasizes both short- and long-run outcomes and that includes some regional detail together with national totals. Some parameters are best simply adopted from existing studies, others estimated from national or regional aggregate time-series data, still others from cross-sectional or panel data. At least several years of effort would be required to transform this model into an operational analytical tool.

A final point about estimation is that work on it can and should be organized so that there are dividends along the way. One approach to providing such dividends is to make work on each key behavioral response in the model—for example, work on wage sensitivity to unemployment in disaggregated labor markets, or on labor supply response to interregional differentials—a self-contained study of one aspect of the impact of immigration. Each study can be organized and written up to help illuminate one topic at the same time that it contributes to empirical implementation of the model.

APPENDIX

EQUATIONS AND PARAMETERS

This appendix lists the variables, the equations with the coefficients used for the reference simulation, and the alterations for each of the other simulations.

Variables

In the list below, i refers to the three types of labor in the model and, in some equations, to persons outside the labor force (1=unskilled; 2=skilled through on-the-job training; 3=skilled through formal education; 4=out of the labor force). The j refers to the two regions (1=region of immigration; 2=rest of country). The n refers to national variables. Variables preceded by an asterisk are exogenous.

E(i,j)	=	employment in each submarket (i=1,2,3; j=1,2)
G(j), G(n)	=	expenditures by regional governments (j=1,2) and by national government
*IMM(i)	=	immigration into region 1 by labor status (i=1,2,3,4)
K(j)	=	capital stock in each region(j=1,2)
L(i,j)	=	labor force in each submarket (i=1,2,3; j=1,2)
N(j)	=	population in each region (j=1,2)
p(j), p(n)	=	price level in each region (j=1,2) and nationally
Q(j), Q(n)	=	output in each region (j=1,2) and nationally
*R(n)	=	cost of capital; ratio of service cost per unit of capital stock to national price level in year (t-1)
S(j)	=	stock of unskilled immigrants in each region (j=1,2)
*tx(n)	=	national tax rate
TX(j), TX(n)	=	tax receipts collected by each region (j=1,2) and nationally

*TIME = time-trend equal to 11 in the first year, 12 in the second, etc.

u(j) = unemployment as a percent of the labor force in each region (j=1,2)

w(i,j), w(j) = wage rate in each submarket (i=1,2,3; j=1,2) and employment-weighted wage rate in each region (j=1,2)

*Y(n) = current-dollar income, national total.

Equations

The coefficients in the equation listing are those of the reference simulation. Ln refers to natural logarithms; (t-1), (t-2), etc., to lags of one year, two years, etc.

Equations 2, 4, and 7 are derived from a production function with constant elasticity of substitution and from an assumption of profit maximization. The production function is

$$Q(j) = 25\left[\sum_{i=1}^{3} a(i)\, E(i,j)^{\frac{s-1}{s}} + a(k)\, K(j)^{\frac{s-1}{s}}\right]^{\frac{s}{s-1}} \left(e^{0.01(TIME)}\right)$$

The production function does not appear in the model; it can be thought of as an equation for equilibrium or potential output, if labor force times normal utilization rates (see notes to equation 3) are substituted for employment. Values of s and the a's used in the simulations are listed below.

Labor Market Equations (eighteen equations)

$$(1)\quad L(i,j) = L(i,j)(t-1)\,\{1.01 \pm 0.02\,[(w(i,1)/w(i,2)) - 1.0] \pm 0.02[(E(i,1)/L(i,1)(t-1)) - E(i,2)/L(i,2)(t-1)] + 0.0[(w(i,j)/w(j)) - 1.0]\} + [IMM(i) \pm 0.03[S(j)(t-1)]$$

Notes: The two $\pm$ signs mean that the sign is plus for region 1, minus for region 2. The IMM term applies only to the three submarkets of region 1. The last term applies with a minus sign to the two unskilled labor markets and with a plus sign to the markets for labor skilled through training.

$$(2)\quad \ln(Ei,j) = \{(s-1)\ln(25) + sa(i) + .01(s-1)(TIME) + \ln Q(j) - 0.25\,\Delta\ln Q(j) - 5\ln[0.5(w(i,j)/p(j)) + 0.3(w(i,j)/p(j)(t-1)) + 0.2(w(i,j)(t-2)/p(j)(t-2))]\} * (1.00 + 0.05 + 0.05)$$

Notes: s is the elasticity of substitution, equal to 0.5 in the reference simulation. a(i) is a set of coefficients reflecting the relative efficiency of different kinds of labor. In the reference simulation, a(1)=0.5, a(2)=1.0, and a(3)=1.5. The final term, (1+.05+.05), reflects employment demands by regional and national governments, which are assumed to use the three types of labor in the same proportions as the private sector.

$$(3)\quad \Delta\ln w(i,j) = .01 + 0.2\,\Delta\ln p(j) + 0.4\,\Delta\ln p(j)(t-1) + .04\,\Delta\ln p(j)(t-2) - 2.0\ln[b(i)\,L(i,j)/E(i,j)] - 0.1[IMM(i)/L(i,1)]$$

Notes: A set of coefficients, b(i), reflects the equilibrium ratio of employment to labor force for each type of labor. In the reference simulation, b(1)=.94, b(2)=.95, and b(3)=.96.

Price, Output, and Capital Demand Equations (six equations)

(4) $p(j) = 25^{-1} e^{-0.01(TIME)} \left[\sum_{i=1}^{3} a(i)^s \, w(i,j)^{1-s} + a(k)^s \, (R(n) \, p(j)(t-1))^{1-s} \right]^{\frac{1}{1-s}}$

Notes: The elasticity of substitution, s, is equal to 0.5 in the reference simulation. The set of coefficients a(i) reflects the relative efficiency of different types of labor and of the capital stock. In the reference simulation, a(1)=0.5, a(2)=1.0, a(3)=1.5, and a(k)=16.0.

(5) $Q(1) = [Y(n)/p(1)] \left[\sum_{i=1}^{3} L(i,1) / \sum_{i=1}^{3} \sum_{j=1}^{2} L(i,j) \right] \left[1.0 + 0.0 \sum_{k=1}^{3} (p(1)(t-k)/p(2)(t-k) - 1.0) \right]$

Note: This equation can be rearranged to say that current-dollar output per member of the labor force in region 1 relative to the nation depends on current and lagged relative prices.

(6) $Q(2) = [Y(n) - Q(1)p(1)] \; / \; p(2)$

Note: This equation, an identity, can be rearranged to express national current-dollar output as the sum of current-dollar output in the two regions.

(7) $\ln K(j) = (s-1) \ln(25) + sa(k) + .01(s-1)TIME + \ln[.5Q(j) + .5Q(j)(t-1) + 0.0 \, Q(j)(t-2)] - s[.5 \, R(n) + .3 \, R(n)(t-1) + .2 \, R(n)(t-2)]$

Note: The elasticity of substitution, s, is equal to 0.5 in the reference simulation. The coefficient a(k) reflects the efficiency of the capital stock, equal to 16.0 in the reference simulation.

Other Behavioral Equations (8 equations)

$$(8)\quad G(j) = \{0.05\,Q(j) + 0.05\,[N(j) - \sum_{i=1}^{3} L(i,j)] + 0.05\,[\sum_{i=1}^{3} (L(i,j) - E(i,j)] + 0.05\ N(j)\}\ p(j)$$

$$(9)\quad TX(j) = [G(j)(t-1)/Q(j)(t-1)\ p(j)(t-1)]\ Q(j)\ P(j)$$

$$(10)\quad G(n) = \{.05\,Q(n) + 0.5\,[\sum_{j=1}^{2} (N(j) - \sum_{i=1}^{3} L(i,j))] + 0.5\,[\sum_{i=1}^{3}\ \sum_{j=1}^{2} (L(i,j) - E(i,j))]\}\ p(n)$$

$$(11)\quad TX(N) = tx(n)\,Y(n) + [0.05\ Q(n) + 0.0\ \sum_{j=1}^{2} w(1,j)\,S(j)]\ p(n)$$

$$(12)\quad N(j) = \sum_{i=1}^{3} [L(i,j) + 0.025\,L(i,j)(t-1)] + 0.98\,[N(j)(t-1) - \sum_{i=1}^{3} L(i,j)(t-1)] \pm 0.02\,[p(1)/p(2) - 1.0]\,[N(i)(t-1) - \sum_{i=1}^{3} L(i,1)(t-1)] + IMM(4)$$

Note: The final term in equation (12) applies only to region 1.

Identities (six equations)

$$(13)\quad w(j) = \sum_{i=1}^{3} [w(i,j)\,E(i,j)]\ /\ \sum_{i=1}^{3} E(i,j)$$

$$(14)\quad u(j) = \sum_{i=1}^{3} [L(i,j) - E(i,j)]\ /\ \sum_{i=1}^{3} L(i,j)$$

$$(15)\quad Q(n) = Q(1) + Q(2)$$

(16) p(n) = Y(n) / Q(n)

Simulations

Each simulation is a comparison of the outcomes of two runs of the model, one with a higher flow of immigration than the other. In the "low" run, IMM(1) is 1 million every year, while IMM(2), IMM(3), and IMM(4) are zero. In the "high" run, for all the simulations except the final one, IMM(1) begins at 2 million in year 1 and grows by 2.5 percent per year; while IMM(2), IMM(3), and IMM(4) are again zero. Values of IMM(i) for the final simulation are listed in the description of that simulation.

The reference simulation is based on the coefficients listed in the previous section of this appendix.

Simulation of greater substitutability of inputs raises s in equations 2, 4, and 7 from 0.5 to 1.5. It also changes the a(i) in those equations as follows: a(1) from 0.5 to 0.09; a(2) from 1.0 to 0.17; a(3) from 1.5 to 0.26; and a(k) from 16.0 to 0.043. These changes are necessary to keep the distribution of income among the labor subgroups and owners of capital within plausible ranges.

Simulation of faster immigrant upgrading changes the coefficient of S(j) in equation (1) from 0.03 to 0.06.

Simulation of less sensitivity of wages to unemployment changes the coefficient of ln (b(i) L(i,j) / E(i,j)) in equation 3 from -2.0 to -0.5.

Simulation of wage rigidity substitutes the equation w(i,j) = w(i,j)(t-1) for equation 3 whenever that equation leads to a decrease in wage rates.

Simulation of less interregional supply sensitivity changes the coefficients of w(i,1)/w(i,2) and of [(E(i,1)/L(i,1))-(E(i,2)/L(i,2))] in equation 1 from 0.02 to zero.

Simulation of less interregional demand sensitivity changes the coefficient of $\sum_{H=1}^{3}$ [p(1)(t-k)/p(2)(t-k)] in equation 5 from zero to 0.1.

Simulation of change in the skill distribution of immigrants uses the same coefficients and "low" immigration run as the reference simulation. For the "high" immigration run, it redistributes the difference between "high" and "low" values of IMM(1) used in the other runs as follows; 60 percent to IMM(1), 30 percent to IMM(2), and 10 percent to IMM(3).

References

Chiswick, Barry R. 1982a. "The Economic Progress of Immigrants: Some Apparently Universal Patterns." In The Gateway: U.S. Immigration Issues and Policies, edited by Barry R. Chiswick, 119-158. Washington, D.C.: American Enterprise Institute.

_____. 1982b. "The Impact of Immigration on the Level and Distribution of Economic Well-Being." In The Gateway: U.S. Immigration Issues and Policies, 289-313. Washington, D.C.: American Enterprise Institute.

Johnson, George E. 1980. "The Labor Market Effects of Immigration." Industrial and Labor Relations Review, 33 (April): 331-341.

Piore, Michael J. 1979. Birds of Passage: Migrant Labor and Industrial Societies. Cambridge, Mass.: Cambridge University Press.

The Urban Institute

IMPACTS OF IMMIGRATION IN CALIFORNIA

Related Titles

de la Puente, Manuel, and Marc Bendick, Jr., "Employment and Training Programs for Migrant and Refugee Youth: Lessons from the United States Experience." The Urban Institute, August 1983.

Muller, Thomas, The Fourth Wave: California's Newest Immigrants, A Summary. Washington, D. C.: The Urban Institute Press, 1984.

Espenshade, Thomas J., and Tracy Ann Goodis, "Recent Immigrants to Los Angeles: Characteristics and Labor Market Impacts." Urban Institute Policy Discussion Paper PDS-85-1, May 1985.

Koss, Margo, and Harry Hatry, "Human Services Needs and Resources in Long Beach." Urban Institute report to the City of Long Beach, May 1985. Also available from City Manager's Office, City of Long Beach, California.

Manson, Donald M., Thomas J. Espenshade, and Thomas Muller, "Mexican Immigration to Southern California: Issues of Job Competition and Worker Mobility." Urban Institute Policy Discussion Paper PDS-85-2, August 1985.

Connor, Walker (ed.), Mexican-Americans in Comparative Perspective. Washington, D. C.: The Urban Institute Press, 1985.

Muller, Thomas, and Thomas J. Espenshade, The Fourth Wave: California's Newest Immigrants. Washington, D. C.: The Urban Institute Press, 1985.

de Leeuw, Frank, "The Economic Effects of Immigration: Specification of a Model." Urban Institute Policy Discussion Paper PDS-85-3, December 1985.

Taylor, J. Edward, "Selectivity of Undocumented Mexico-U.S. Migrants and Implications for U.S. Immigration Reform." Urban Institute Policy Discussion Paper PDS-85-4, December 1985.

Eow To Inquire about Papers and Publications

For information about obtaining copies of Policy Discussion Papers and other Urban Institute papers, contact the Library/Information Clearinghouse, The Urban Institute, 2100 M Street, N.W., Washington, D. C. 20037; telephone (202) 857-8688 or (202) 857-8687.

For information about obtaining copies of Urban Institute Press publications, contact The Urban Institute Press, P.O. Box 19958, Hampden Station, Baltimore, Maryland 21211; telephone (301) 338-6951.